

УПРАВЛІННЯ В ОРГАНІЗАЦІЙНИХ СИСТЕМАХ

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QUANTITATIVE RISK ANALYSIS OF IT-STARTUPS

When working with an IT startup, a young developer will always encounter difficulties in analyzing risks. Since there are quite a few options and methods for analysis, it was decided to investigate some of the most effective methods of risk analysis. Also, the implementation of a startup, as a rule, is based on attracting external financing. But more often than not, the investor is interested not only how effective this project is in case of its successful implementation, but also what is the likelihood of a positive effect, that is, how much all risk factors capable of influencing the project are taken into account. So, one more confirmation of the relevance of the application of risk analysis is help in finding sources of project financing. The aim of the study is to analyze possible methods for quantitative risk analysis of an IT startup, with consideration of the most practical methods for solving risk analysis tasks. The advantages of a qualitative risk assessment are the ease of understanding and implementation, the ability to rank risks using characteristics or color codes. Outwardly, the methodology for a qualitative assessment of project risks seems very simple – descriptive, but in essence it should lead the analyst to a quantitative result, that is, a valuation of the identified risks, their negative consequences and stabilization measures. In the process of research, we consider: the method of reliable equivalents, the scenario method, sensitivity analysis, and the Monte Carlo method. The goal as a result is to simplify the risk analysis for IT startups, as well as to achieve maximum efficiency and understanding the degree of influence of risks on IT startups for their further elimination or mitigation.

Keywords: IT-startup, quantitative risk analysis, model, analysis of the sensitivity, scripting method, imitation model.

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КІЛЬКІСНИЙ АНАЛІЗ РИЗИКІВ ІТ-СТАРТАПІВ

При роботі з ІТ-стартапом молодий розробник завжди зіткнеться з труднощами при аналізі ризиків. Оскільки варіантів і методів для аналізу існує досить багато, було прийнято рішення досліджувати деякі з найбільш ефективних методів аналізу ризиків. Також реалізація стартапу, як правило, заснована на залученні зовнішнього фінансування. Але найчастіше інвестору цікаво не тільки, наскільки ефективний цей проект в разі його успішної реалізації, а й наскільки ймовірним є отримання позитивного ефекту, тобто наскільки враховані всі ризикові чинники здатні вплинути на проект. Так, ще одним підтвердженням актуальності застосування ризик-аналізу стає допомога в пошуку джерел фінансування проекту. Метою дослідження є аналіз можливих методів кількісного аналізу ризиків ІТ-стартапу, з розглядом найбільш практичних методів для вирішення завдань з аналізу ризиків. Достоїнствами якісної оцінки ризиків є простота розуміння і реалізації, можливість ранжирування ризиків з використанням характеристик або кольорних позначень. Методика якісної оцінки ризиків проекту зовні представляється дуже простий – описовою, але по суті вона повинна привести аналітика до кількісного результату, тобто вартісної оцінки виявлених ризиків, їх негативних наслідків і стабілізаційних заходів. У процесі дослідження розглянемо: метод достовірних еквівалентів, метод сценаріїв, аналіз чутливості та метод Монте Карло. Завдання в результаті спростити аналіз ризиків для ІТ-стартапів, а також досягти максимальної ефективності та розуміння ступеня впливу ризиків на ІТ-стартап для їх подальшого усунення, або пом'якшення.

Ключові слова: ІТ-стартап, кількісний аналіз ризиків, модель, аналіз чутливості, метод сценаріїв, імітаційне моделювання.

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КОЛИЧЕСТВЕННЫЙ АНАЛИЗ РИСКОВ ИТ-СТАРТАПОВ

При работе с ИТ-стартапом молодой разработчик всегда столкнется с трудностями при анализе рисков. Поскольку вариантов и методов для анализа существует довольно много, было принято решение исследовать некоторые из самых эффективных методов анализа рисков. Также реализация стартапа, как правило, основана на привлечении внешнего финансирования. Но чаще всего инвестору интересно не только, насколько эффективен этот проект, в случае его успешной реализации, но и какова вероятность получения положительного эффекта, то есть насколько учтены все рискованные факторы способные повлиять на проект. Так, еще одним подтверждением актуальности применения риск-анализа становится помощь в поиске источников финансирования проекта. Целью исследования является анализ возможных методов количественного анализа рисков ИТ-стартапа, с рассмотрением наиболее практичных методов для решения задач по анализу рисков. Достоинствами качественной оценки рисков является простота понимания и реализации, возможность ранжирования рисков с использованием характеристик или цветовых обозначений. Методика качественной оценки рисков проекта внешне представляется очень простой – описательной, но по сути она должна привести аналитика к количественному результату, то есть стоимостной оценке выявленных рисков, их негативных последствий и стабилизационных мер. В процессе исследования рассмотрим: метод достоверных эквивалентов, метод сценариев, анализ чувствительности и метод Монте Карло. Задача в результате упростить анализ рисков для ИТ-стартапов, а также достичь максимальной эффективности и понимания степени влияния рисков на ИТ-стартап для их дальнейшего устранения или смягчения.

Ключевые слова: ИТ-стартап, количественный анализ рисков, модель, анализ чувствительности, метод сценариев, имитационное моделирование.

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Introduction. The process of rapid development of technologies and methods of approach to the creation and implementation of these innovative ideas is also changing. However, despite the time and change, one thing will always remain when dealing with something new, namely the risks.

When creating something new, unknown to anyone, the risks involved in creating and entering a large market will always be relevant. However, the methods and approaches to addressing these issues will change on this subject will devote this article. The question of risk analysis is expanding every year and young startups are faced with it. The numbers of methods are so large, and it becomes difficult to choose some methods to achieve the maximum result. There are also problems with the calculation and determination of the importance of risks. In this article, we focus only on quantitative analysis methods. Quantitative analysis methods are also a decent amount. That is why we will focus on the main methods that will lead the developer or analyst to the maximum result.

The main goal of this work is to analyze the optimal quantitative methods of risk analysis. This in result will lead to facilitating the promotion of a future product, and reducing the likelihood of risk. That is, the correct approach to calculations and the choice of methods is almost a half-successful startup.

There are also several different methods for quantifying risk. Risk can be accounted for in two ways: increasing the discount rate on the riskiness of a project or by reducing the value of full cash flows.

The discount rate implies marginal (minimum acceptable) profitability or alternative costs of raising capital (alternative cost of capital). In the absence of risk factors for the project, the yield on government bonds is used in practice as such alternative investment. The riskier, the project, the higher the requirements for its profitability. In calculations, these requirements are reflected by increasing the discount rate, so when evaluating project performance, there is a question of justifying the discount rate.

Consider one of the most common methods of adjusting your discount rate:

CAPM – Capital Assets Pricing Model

Foreign risk accounting is also used to determine the risk adjustment CAPM (Capital Asset Pricing Model):

$$E(R_i) = R_f + \beta(E(R_m) - R_f), \quad i = 1, \dots, N,$$

where R_i – expected return on the stock market;

R_f – risk-free rate (risk-free return on investment);

R_m – average market profitability (risky assets);

$(E(R_m) - R_f)$ – Equity Risk Premium;

β – a measure of systematic risk (a factor that reflects the sensitivity of the stock firm's fluctuation to the fluctuation of the stock of all firms in the industry) [1].

The problem with this model for assessing risky projects is that it only takes into account market risks. Also the problem of using a method to evaluate startup projects is the difficulty of determining an industry indicator β .

N. Jensen developed a modification of this formula:

$$R_e = R_f + \beta(R_m - R_f) + \alpha + \varepsilon,$$

where α – the part of the risk premium that depends on the rating of the firm and the qualifications of the managers;

ε – the part of the risk premium that reflects non-systematic risk (figure up related to fluctuations in market prices for resources, yields of securities) [2].

These methods are not uniform, but they are considered to be the most appropriate to determine the risk rate of a new company and do not require a retrospective assessment.

To account for cash flow risks, we consider two more methods:

1. The method of reliable equivalents:

In applying this method, risk accounting is based on the mathematical expectation of cash flow for each estimated period:

$$X_{yn} = \sum_{i=1}^n P_k X_k,$$

where X_{yn} – the probability of obtaining the result x_i ;

P_k – the result of an event or result;

X_k – the number of variants of the results of events.

Probability X_{yn} reflects the degree of confidence that the full value of the expected cash flow will be received and, in the absence of uncertainty, becomes the downward factor for the cash flow of each project implementation period. The determination of the probability of cash inflows is established, as a rule, by expert judgment [3].

2. The scripting method

Scenario analysis involves consideration of several possible options for project development. The guidelines provide an analysis of the following likely scenarios:

- various forecasts of the general inflation index, price indexes and the internal inflation index (or other characteristic of changes in purchasing power) of foreign currency;
- change of tax system;
- different climatic conditions of the project implementation;
- the emergence of competing cheaper products or technologies in the market;
- reinforcement of various rules and regulations that require additional costs, etc.

In the simplified version, three possible project development situations need to be simulated: optimistic (that is, the risk factors did not affect the project), pessimistic (when all risk factors worked), and most likely, then calculating the net present value for each [4]. Then, based on the peer review, the probability of each scenario is determined and the mathematical expectation of the NPV is determined:

$$NPV = \sum_{t=1}^n \frac{CIF_t}{(1+IRR)^t} - \sum_{t=1}^n \frac{COF_t}{(1+IRR)^t} = 0,$$

where IPR – internal rate of return. A positive indicator NPV is guaranteed if $IPR > r$, in this case, the project is approved for implementation [5].

There are often situations where there is no information about the likelihood of a particular scenario. In solving this problem, the rule is 6 sigma, which uses the

weighted average pessimistic, optimistic and the most probable estimation:

$$tE = \frac{cO + 4 \cdot cM + cP}{6},$$

where tE – expected cost of the project;

cO – the cost of the project in the implementation of the pessimistic scenario;

cM – project cost in the most likely scenario;

cP – project cost in a pessimistic scenario [6].

3. Analysis of the sensitivity of the project effectiveness

The method of estimating the step of filling in variative parameters on the main indicators of the project's effectiveness, which is the order of the project's rank. The structure of the key parameters of the project (NPV, IRR, PI) shows the most significant factors (for example, sales margin, real value) [7]. The next crock-change of the most critical winter in the international range and analysis of the indicator of efficiency in new minds. The level of correlation between the significant and significant indicators of effectiveness and the degree to which the project will reach the level of success. This assessment carried out severally for the skin factor. Thus, the last estimate of the factors factor is NPV, IRR, PI, and the most recent indicators, so that they can have the greatest impact on the success of the project [8].

With a region of empathy, it's important to win the respect not only by rubbing it when realizing, but by doing it with a positive result, so as if you can significantly overlook negative negligence [9].

For the assessment of the important importance of winter victorious diagram "Tornado" – see fig. 1.

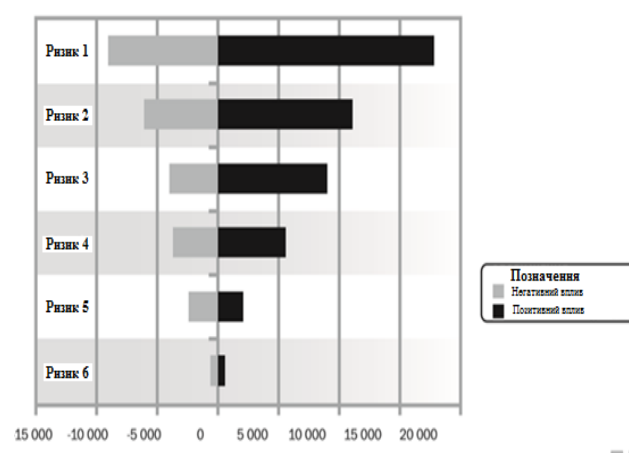


Fig. 1. Tornado Diagram

For the vertical axis, critical parameters are indicated for sensitivity analysis, for the horizontal axis – for the assessment of the norm with the constant value of the parameters [10].

4. Monte Carlo Method (imitation model)

Simulation modeling involves statistical analysis using a large array of data. Unlike considering a limited number of scenarios, the Monte Carlo method investigates all possible combinations, that is, the consideration of the distribution of probable results [11]. Within this method, we create an accurate model (simulation) of the project,

based on uncertain parameters, as well as the range of their fluctuations, taking into account the probability distribution. Then, using special application packages, we simulate the values of the given parameters [12]. As a result, we get accurate cash flows with forecast errors. So the Monte Carlo method has three steps: project modeling, Determination of the probability of error in the forecast, selection of forecast error values and cash flow calculation.

Findings. After analyzing the main quantitative methods for evaluating the effectiveness of IT startups, we can conclude that perhaps the most effective methods of this analysis are sensitivity analysis and scenario method. A sensitivity analysis is a good example of a Tornado analysis. As for the scenario method, its use is also very effective in analyzing possible risks. Since when using this method, a series of tests are formed that calculate the state of the project if the risks under consideration nevertheless come true. Closely related to the scenario is method simulation (Monte Carlo method). It is this bunch that gives maximum efficiency in such an analysis. It can be concluded that when evaluating an IT startup, it is also rational to use these methods of quantitative analysis to understand the possible impact of risks on the project and to prevent them.

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